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Metastatic tumors to the ovaries: a study of 170 cases in northern Thailand

S. KHUNAMORNPONG*, P. SUPRASERT†, W. NA CHIANGMAI‡ & S. SIRIAUNKGUL*
*Departments of *Pathology, †Obstetrics and Gynecology, and ‡Radiology, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand*

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The cases of malignant ovarian tumors treated at Chiang Mai University hospital between 1992 and 2003 were histologically reviewed. The medical records, the radiologic findings, and the follow-up outcome in the cases suspicious or diagnostic of metastases were reviewed to confirm the diagnosis and to determine the primary sites. Metastatic tumors accounted for 30% of malignant ovarian tumors. A total of 170 cases of metastatic tumors included 117 cases with nongynecologic origin and 53 cases with gynecologic origin. Nongynecologic metastatic tumors were from large intestine (31%), stomach (14%), intrahepatic bile duct (10%), breast (9%), extrahepatic bile duct/gallbladder (7%), appendix (5%), hematologic tumors (3%), others (4%), and unknown primary site (16%). Metastatic gynecologic tumors were from cervix (53%), corpus (34%), fallopian tube (11%), and gestational trophoblastic disease (2%). The proportion of metastatic tumors to malignant ovarian tumors in northern Thailand was comparable to those of the Western or Japanese studies. However, the distribution of the primary sites was different and was correlated with the cancer incidence in Thai women. The majority of mucin-producing adenocarcinomas involving the ovaries were metastatic tumors.

KEYWORDS: metastatic tumor, mucinous adenocarcinoma, ovary.

The ovary is a frequent site for metastatic involvement[1]. The frequency of metastatic tumors in surgical pathology may be as high as 30–40% of malignant neoplasms involving the ovaries[2–4]. Metastatic tumors are not uncommonly confused with primary ovarian tumors[3]. Difficulty in diagnosis depends on the degree to which metastatic lesions simulate the primary tumors. Distinction between primary and metastatic ovarian tumors is important because misinterpretation of a metastatic tumor as a primary tumor may lead to inappropriate management and suboptimal treatment outcome[5].

Mucin-producing adenocarcinomas account for the majority of metastatic tumors and frequently cause diagnostic difficulties[3,5–9]. In a recent study, Seidman *et al.*[7] reported that most mucinous adenocarcinomas involving the ovaries were metastatic tumors and that mucinous adenocarcinoma accounted for a low proportion of primary ovarian carcinomas. It was also suggested that some of the previously published data on primary ovarian mucinous adenocarcinoma in the literature might be unreliable[10]. In Thailand, there has been no study of metastatic tumors to the ovaries. Previous data of ovarian cancer in Thailand collected from the cancer registry reported that mucinous adenocarcinoma was the most common subtype of malignant epithelial tumors of the ovary[11]. In our routine surgical pathology practice, mucinous adenocarcinomas involving the ovaries were commonly observed but, in many cases, with pathologic or clinical features that were suspicious for metastatic lesions. This observation led us to review the cases of malignant ovarian tumors treated in our institution, Chiang Mai University (CMU) hospital in northern Thailand.

The purpose of this study was to evaluate (a) the frequency of metastatic tumors among the malignant ovarian neoplasms in northern Thailand with emphasis in the mucinous tumor group, (b) the site distribution of primary cancers for ovarian metastasis, and (c) clinicopathologic features of metastatic tumors and the diagnostic problems.

Address correspondence and reprint requests to: Surapan Khunamornpong, MD, Department of Pathology, Faculty of Medicine, Chiang Mai University, Chiang Mai 50200, Thailand. Email: skhunamo@mail.med.cmu.ac.th

Materials and methods

The surgical pathology files of the Department of Pathology, Faculty of Medicine, CMU, between January 1992 and December 2003 (12-year period) were searched for ovarian epithelial tumors of low malignant potential (LMP), and malignant ovarian neoplasms, either primary or metastatic. For inclusion in the study, the ovarian tissue must be removed for pathologic examination. Cases with only small tumor biopsy were excluded. The histologic slides of LMP and malignant ovarian tumors were reviewed and classified according to the WHO classification[12]. The distinction between primary and metastatic tumors was based on the diagnostic approach criteria of Young and Scully[13]. Particular attention was paid to the groups of mucinous LMP tumors and mucinous adenocarcinomas. The diagnosis of primary mucinous adenocarcinoma required exclusion of the possibility of metastasis by the clinical/radiologic investigation including available follow-up outcome. The diagnosis of metastatic mucinous adenocarcinoma was based on the criteria by Lee and Scully[8]. Ovarian noninvasive mucinous tumors associated with pseudomyxoma ovarii and/or appendiceal mucinous tumors were not included in the metastatic group. These ovarian tumors usually show the features of mucinous LMP tumors and are classified in such a category in the current classification with acknowledgment that most ovarian lesions represent secondary involvement from appendiceal tumors[12]. The large majority of the cases with ovarian tumors resected in the CMU hospital had the gross specimens of the ovaries reviewed by either or both pathologists (S.K. and S.S.) and had adequate tissue sampling. For calculation of the proportion of metastatic tumors among malignant ovarian tumors or mucinous adenocarcinomas, only the cases with primary surgery of the ovarian lesions in the CMU hospital were included.

The clinical records of the metastatic cases were reviewed for the previous medical history, the clinical manifestation, the intraoperative findings, the clinical management, and the available outcome including the subsequent investigations. The intraoperative findings and the available radiologic materials were reviewed to confirm the presence of primary tumors and to exclude potential primary sites other than the expected primary lesions.

The pathology reports were reviewed for the macroscopic appearance of metastatic tumors. The tumor size of the metastatic ovarian lesions was obtained from the pathology reports or the operative findings using the maximal dimension of the ovarian masses. If metastatic lesions were small or involved the ovaries partially, only the size of the metastatic foci was recorded.

The slides of metastatic tumors were histologically reviewed in correlation with the macroscopic and the clinical findings. The tumor histologic types were classified based on the morphology in the routine hematoxylin and eosin stain. Adenocarcinomas were further classified as mucin-producing type in the presence of mucin-producing neoplastic cells with or without signet-ring cell component. Immunohistochemical stains were performed in selected cases to confirm the diagnosis. The presence or the absence of the preexisting primary ovarian lesions that were clearly different from the metastatic component was recorded. The presence of benign or LMP-like glands or cysts within an adenocarcinoma of similar histologic type was not sufficient for the diagnosis of the preexisting primary component[13].

The histologic slides of the primary tumors were searched, and the available materials were reviewed to confirm the histologic similarity between the known primary tumors and the metastatic lesions. If the slides of the primary tumor were not available, both the following criteria must be met to specify the site of origin: (a) documentation of the primary malignant tumor by convincing intraoperative and/or radiologic findings or by prior medical records with firm diagnosis of previously known primary tumor and (b) histologic features of the ovarian lesion and, if available, immunohistochemical profiles (particularly cytokeratins 7 and 20) must match those of the usual histologic type of the presumed primary site. For the diagnosis of metastatic tumors of unknown primary site, the pathologic features of the ovarian lesions must be diagnostic of metastatic tumors to the ovaries[5,8,13]. Advanced-stage mucinous adenocarcinomas showing the features suggestive for metastases[6,8] without confirmation of definite primary site were considered as tumors of unclassified origin (primary versus metastatic).

Results

During the 12-year period, there were 170 cases of metastatic tumors to the ovaries identified. One hundred and forty-three cases (84%) had the ovarian lesions resected in the CMU hospital, whereas the rest (16%) were outside cases that were referred for further management mostly with original pathologic diagnosis of primary ovarian cancers. Considering the CMU hospital cases only, during the study period, there were a total of 474 malignant tumors involving the

ovaries, 30% of which were metastatic tumors (Table 1). Regarding mucin-producing adenocarcinomas involving the ovaries in the CMU hospital series, there were a total of 119 cases, 16 (13%) of which were identified as primary mucinous adenocarcinomas, 97 (82%) as unequivocal metastases, and 6 (5%) as tumors of unclassified primary sites.

Of 170 metastatic cases, 117 cases (69%) had primary sites in nongynecologic organs and 53 cases (31%) had gynecologic origin (Table 2). In the nongynecologic group, large intestine was the most frequent primary site, followed by stomach, and intrahepatic bile duct. The only case of metastatic hepatocellular carcinoma was previously reported[14]. Tumors of the gastrointestinal tract accounted for 50% of nongynecologic metastases and those of the biliary system (intrahepatic/extrahepatic bile duct and gallbladder) for 17%. In the group of gynecologic metastases, uterine cervix was the most common primary site, followed by uterine corpus.

Clinical presentation

The median age of the patients was 46 years for the nongynecologic group (range, 18–85) and 51 years for the gynecologic group (range, 20–82). The distribution of metastatic tumors by age group in comparison with that of primary ovarian cancers is shown in Table 3. Metastatic nongynecologic tumors occurred in the slightly younger age group than metastatic gynecologic cancers and primary ovarian carcinomas.

Ovarian metastases were the initial manifestation without previously known primary tumors in 80 of 170 total cases, which included 76 of 117 (65%) nongynecologic cases and 4 of 53 (8%) gynecologic cases. The majority of metastatic nongynecologic cancers presented with nonspecific pelvic or abdominal symptoms such as abdominal mass or increased abdominal girth (36%) and abdominal/pelvic pain or discomfort (38%). Abnormal uterine bleeding was also the presentation in 4%. The relative sequence of the recognition of primary cancers to the resection of ovarian metastases is shown in Table 4. Excluding the cases in which the primary tumors were only immediately identified prior to ovarian resection, the primary cancers were previously known in 20 nongynecologic cases with a median duration of 18 months (range 1–110) and in 15 gynecologic cases with a median duration of 8 months (range 1–31). The longest postoperative duration for detection of the primary sites was 9 months for nongynecologic cancers and 3 months for gynecologic tumors.

Table 1. Distribution of all malignant ovarian neoplasms resected in CMU hospital

Malignant ovarian neoplasms	No. (%)
Epithelial carcinomas	238 (50.2)
Serous	87 (18.4)
Mucinous	16 (3.4)
Endometroid	58 (12.2)
Carcinosarcoma	6 (1.3)
Clear cell	41 (8.6)
Transitional cell	2 (0.4)
Mixed	23 (4.9)
Undifferentiated	5 (1.1)
Sex cord–stromal tumors	24 (5.1)
Adult granulosa cell	12 (2.5)
Juvenile granulosa cell	2 (0.4)
Sertoli–Leydig cell	5 (1.1)
Steroid cell	2 (0.4)
Others	3 (0.6)
Germ cell tumors	59 (12.4)
Dysgerminoma	14 (3.0)
Yolk sac tumor	15 (3.2)
Immature teratoma	17 (3.6)
Teratoma with malignant transformation	7 (1.5)
Carcinoid	3 (0.6)
Mixed	3 (0.6)
Gonadoblastoma with germ cell tumor	3 (0.6)
Soft tissue sarcoma	1 (0.2)
Metastatic tumors	143 (30.2)
Tumors of unclassified primary sites[a]	6 (1.3)
Total	474 (100)

[a]Mucinous adenocarcinomas (primary versus metastatic).

Table 2. Distribution of primary cancers for ovarian metastases in 170 cases

Primary sites	No. (%)
Nongynecologic origin	117 (100)
Large intestine[a]	36 (31)
Stomach	16 (14)
Intrahepatic bile duct	12 (10)
Breast	11 (9)
Extrahepatic bile duct/gallbladder	8 (7)
Appendix	6 (5)
Hematologic tumors[b]	4 (3)
Others[c]	5 (4)
Unknown[d]	19 (16)
Gynecologic origin	53 (100)
Cervix	28 (53)
Corpus	18 (34)
Fallopian tube	6 (11)
Gestational trophoblastic disease[e]	1 (2)

[a]Tumors originated in colon (29) and rectum (7).
[b]Hematologic tumors included three lymphomas and one leukemia.
[c]Other tumors included two pulmonary small cell carcinomas, one nasopharyngeal undifferentiated carcinoma, one pancreatic mucinous adenocarcinoma, and one hepatocellular carcinoma.
[d]Tumors of unknown nongynecologic primary sites included 17 mucin-producing adenocarcinomas and 2 neuroendocrine carcinomas.
[e]Choriocarcinoma.

Table 3. Distribution of metastatic tumors and primary ovarian cancers by age group

	Metastatic tumors		Primary ovarian cancers	
Age group (years)	Nongynecologic, $n = 117$ (%)	Gynecologic, $n = 53$ (%)	Epithelial, $n = 238$ (%)	Nonepithelial, $n = 87$ (%)
≤20	1 (1)	1 (2)	0 (0)	31 (36)
21–30	14 (12)	0 (0)	1 (0.4)	15 (17)
31–40	28 (24)	11 (21)	31 (13)	12 (14)
41–50	31 (26)	12 (23)	78 (33)	13 (15)
51–60	27 (23)	20 (38)	66 (28)	8 (9)
61–70	13 (11)	6 (11)	45 (19)	5 (6)
>71	3 (3)	3 (6)	17 (7)	3 (3)
Median age (years)	46	51	52	29

Macroscopic appearance

The gross appearance of the ovarian lesions known in 164 cases included solid or predominantly solid masses (29%), solid-cystic tumors (37%), predominantly cystic tumors (15%), small intraparenchymal nodules (12%), surface plaques or nodules (2%), and without definite gross lesions (5%). Gross intracystic papillary growth was also recorded in 11 cases (10 colorectal and 1 gallbladder origin).

Bilateral resection of the ovaries for pathologic examination was done in 88% of metastatic nongynecologic cases and in 76% of gynecologic cases. Bilateral ovarian involvement was present in 74% of the nongynecologic group and 47% of the gynecologic group. However, in 40% of nongynecologic metastases and 38% of gynecologic cases, unilateral prominently enlarged ovarian masses were observed. The tumor size was known in 168 cases with a median of 11.6 cm for the nongynecologic group (range, 0.3–29.0) and 4.0 cm for the gynecologic group (range, 0.1–18.0). Most metastatic cancers of nongynecologic origin (62%) were 10 cm or more in maximal dimension, whereas only 9% were less than 5 cm. This was in contrast to metastatic gynecologic tumors that measured 10 cm or more in only 16% but were less than 5 cm in 56% of the cases.

Table 4. The relative sequence of the recognition of primary cancers to the operation for ovarian metastases

Recognition of primary cancers	Total, $n = 170$ (%)	Nongynecologic, $n = 117$ (%)	Gynecologic, $n = 53$ (%)
Preoperative	71 (42)	31 (27)	40 (75)
Intraoperative	43 (25)	32 (27)	11 (21)
Postoperative	37 (22)	35 (30)	2 (4)
Unknown primaries	19 (11)	19 (16)	—

Histopathology

Adenocarcinoma was the most common histologic type of metastatic tumor (91% of the nongynecologic group and 70% of the gynecologic group). Mucin-producing adenocarcinomas were identified in 116 of 170 cases (68%), which accounted for 86% of the nongynecologic group and 30% of the gynecologic group. The signet-ring cell component was seen in 38 cases (focal in 12 and predominant in 26) and accounted for 36% of mucin-producing adenocarcinomas of nongynecologic origin and only 13% of those of gynecologic origin.

The histologic types of uterine cervical cancers included 17 adenocarcinomas, 3 adenosquamous carcinomas, and 8 squamous cell carcinomas. Metastatic tumors from the uterine corpus included 14 adenocarcinomas and 4 sarcomas (2 low-grade endometrial stromal sarcomas, 1 leiomyosarcoma, and 1 undifferentiated stromal sarcoma).

Well-differentiated mucin-producing adenocarcinomas, without signet-ring cells, that were morphologically similar to primary ovarian mucinous adenocarcinomas were observed in 48 of 170 cases (28%). Of these 48 cases, the primary sites included cervix (27%), intrahepatic bile duct (23%), large intestine (17%), extrahepatic bile duct/gallbladder (8%), stomach (4%), appendix (4%), pancreas (2%), and unknown primary site (15%). In the latter group with unknown primary site, the clinicopathologic features were suspicious for biliary origin in four of seven cases. Of 38 adenocarcinomas with signet-ring cell component, the primary sites included stomach (34%), large intestine (16%), appendix (8%), breast (8%), cervix (5%), extrahepatic bile duct (3%), and unknown primary site (26%).

Metastatic tumors to preexisting primary ovarian lesions were seen in 10 of 170 cases (6%). These included two mature cystic teratomas, two Brenner tumors, two

mucinous cystadenomas, one mucinous LMP, one serous cystadenoma, one struma ovarii, and one endometriosis.

Discussion

The information of metastatic tumors to the ovaries in the English literature was limited to the series from developed countries such as the Western countries and Japan[1,2,4,15–18]. Awareness of the frequency of ovarian metastatic tumors and the distribution of the primary cancer sites is a part of the basis for the diagnosis and the management of patients with malignant ovarian lesions. Recently, there has been significant progress in the diagnostic criteria to distinguish between primary and metastatic tumors, particularly in the mucinous adenocarcinoma group which is the most problematic in the diagnosis and comprises the most common type of metastatic tumors to the ovaries[5–9,13]. To our knowledge, there has been no large series of ovarian metastatic tumors using the recent diagnostic criteria from Southeast Asia or other developing countries.

Metastatic tumors accounted for 30% of malignant ovarian neoplasms in northern Thailand. Such a proportion was comparable to that of the Western and the Japanese reports[2,4,16] despite much lower incidence of gastrointestinal cancers in Thai women compared to Western and Japanese women[11,19]. The lower incidence of gastrointestinal cancers in our population was probably balanced by the low incidence of primary ovarian cancers in northern Thailand with age-standardized incidence rate (ASR) of 4.4 per 100,000 women[19].

The distribution of primary cancers for ovarian metastasis seemed to be parallel with the incidence of malignancies in the female population studied. The most common nongynecologic primary tumor in the Western series was either large intestine (32–46%)[2,18] or breast (34–54%)[1,16,17], whereas stomach was the most common primary site in Japan (30–61%)[4,15]. In our series, predomination of metastatic colorectal adenocarcinoma was similar to that of the Western reports[1,2]. The second most common primary tumor was gastric adenocarcinoma which corresponded with the incidence of gastrointestinal cancers in northern Thai women (ASR was 6.5 for the large intestine and 4.9 for the stomach)[19]. Intrahepatic cholangiocarcinoma was the third of nongynecologic tumors for ovarian metastasis. Metastasis of intrahepatic cholangiocarcinoma to the ovaries has been very rarely reported in the literature[3,20]. This may at least in part be associated with the relative rarity of intrahepatic cholangiocarcinoma outside Thailand[11]. Intrahepatic cholangiocarcinoma is common in Thailand, with the highest world incidence of the cancer in the northeast region[11]. Occurrence of intrahepatic cholangiocarcinoma in Thailand has been linked to infection by *Opisthorchis viverrini* which is endemic in the northeast and the northern parts of the country[21]. In the CMU hospital, both intrahepatic cholangiocarcinoma and hepatocellular carcinoma were common hepatic cancers with almost equal estimated incidence (ASR of 5.3 and 5.1, respectively)[21]. However, metastatic hepatocellular carcinoma to the ovary was much less common than metastatic cholangiocarcinoma. This finding may be correlated with the metastatic pattern of hepatocellular carcinoma in which intraperitoneal spread is uncommon[22]. The biliary tract was an important site of origin for ovarian metastatic tumors in our study similar to the finding in a Japanese autopsy series[15]. Metastatic breast carcinoma was much less common than in the Western and Japanese reports[1,2,4,16,17] probably due to the lower incidence of breast cancer in Thailand (ASR of 14.6)[19].

In the group of metastatic tumors of gynecologic origin, uterine cervix was the most common primary site. The frequency of metastatic cervical carcinomas was twice that of metastatic endometrial carcinomas. This was in contrast to the data in the Western and Japanese series where metastatic endometrial carcinomas were more common than those of the cervix[1,2,4,16]. The increased proportion of metastatic cervical cancers was correlated with the high incidence of cervical cancers in the northern Thai population (ASR of 25.6) and the relatively low incidence of endometrial cancers (ASR of 3.5) compared to that of the developed countries[19].

Metastatic nongynecologic tumors to the ovaries tend to occur in young women[3]. In women aged 21–40 years, metastatic nongynecologic tumors were more common than either primary epithelial or primary nonepithelial cancers (Table 3). The possibility of metastatic tumors should be borne in mind in the evaluation of ovarian masses in young patients. The median age of the patients with nongynecologic ovarian metastases in our study was comparable to that of the Japanese series[4] and was slightly lesser than that of the Western reports (52–55 years)[16–18].

Ovarian metastases were the initial manifestation in the majority of nongynecologic cancers. The presentation of these cases frequently caused clinical confusion for primary ovarian tumors. The fact that primary tumors of the nongynecologic group were known prior to the resection of ovarian metastases in only 27% reflected the delay of cancer detection in our population.

In our limited-resource setting, it was not practical to have complete preoperative investigations to rule out other primary tumors for all suspected cases of ovarian cancers. Thus, careful intraoperative examination of the intra-abdominal organs and intraoperative consultation became the crucial part for evaluation of the possibility of ovarian metastasis. In the cases with previously known primary tumors, late metastasis was more common in nongynecologic tumors than in gynecologic cancers.

Macroscopic findings of metastatic tumors were frequently similar to those of primary ovarian tumors. Cystic components and papillary structures were observed. Bilaterality was detected in a high proportion of nongynecologic metastasis and was an important clue in the diagnostic approach for metastatic tumors[5–9]. However, unilateral dominant enlargement of the ovarian metastases seen in approximately 40% of cases may lead to an initial impression of primary ovarian cancers. Tumor size was reported to be another important diagnostic clue for metastatic mucin-producing adenocarcinomas to the ovary as most metastatic tumors had tumor size of less than 10 cm in contrast to primary mucinous adenocarcinomas[7,9,15]. In our study, approximately 60% of metastatic mucin-producing adenocarcinomas had a tumor size of 10 cm or more, which may be correlated with the rather late presentation of the cases when pelvic symptoms of the masses developed.

Among metastatic tumors with great potential to simulate primary ovarian mucinous adenocarcinomas histologically, the biliary system and cervix were the most common primary sites in our series. Metastatic pancreatic adenocarcinoma, which was one of the most frequent mimics of ovarian mucinous adenocarcinomas in the Western studies[7], was uncommon in our series probably because of the lower incidence rate of pancreatic cancer in northern Thailand (ASR of 2.4)[19].

Diagnostic difficulties of metastatic tumors from two primary sites should be addressed: the intrahepatic bile duct and the appendix. Due to the exceptional rarity of ovarian metastatic tumors of hepatic origin in the literature, metastatic intrahepatic cholangiocarcinomas in the CMU hospital were initially considered as an unlikely and unfamiliar diagnosis by our clinical colleagues. On the other hand, the cases were initially recorded as primary ovarian mucinous adenocarcinomas with parenchymal hepatic metastases when other possible primary tumors had been excluded. The ovarian gross appearance and the histomorphology of metastatic intrahepatic cholangiocarcinomas were similar to those of primary ovarian mucinous adenocarcinomas, as well as the immunologic profiles for cytokeratins 7 and 20[23]. Due to the peripheral location of intrahepatic cholangiocarcinomas, jaundice was not detected at the presentation. The diagnosis in these cases required clinicopathologic and radiologic review and, in some cases, repeated investigations[13]. Metastatic tumors of appendiceal origin also caused diagnostic problems because all primary tumors were small in contrast to large ovarian metastatic lesions. The appendiceal lesions were interpreted as metastatic involvement in the initial pathology reports in all cases. If the appendices were not removed for pathologic examination, the presence of primary tumors could not be confirmed and the cases may be interpreted as metastatic tumors of unknown primary site or even as advanced-stage primary ovarian mucinous carcinomas[24].

The presence of teratoma, Brenner tumor, or other primary ovarian lesions in any mucinous tumors of the ovary was considered to be a strong indicator of primary tumors[6]. The finding that metastatic tumors involved preexisting ovarian lesions in 6% of cases in our study indicated that the presence of the primary component, although helpful in supporting the diagnosis of primary ovarian cancer, should be interpreted with care and should not prevent a diagnosis or a suspicion of metastatic tumors.

The previous studies of ovarian epithelial tumors in the literature showed a frequency of mucinous adenocarcinoma of 6–25% among the primary ovarian carcinomas with the highest rate from a study in Thailand[7,25]. The tumor registry in Thailand also reported a proportion of mucinous adenocarcinoma of 32% among primary malignant ovarian tumors[11]. In our study, most of mucinous adenocarcinomas involving the ovary were not primary tumors when the current diagnostic criteria were applied. The finding was in agreement with that of the recent hospital series by Seidman *et al.*[7]. Mucinous adenocarcinomas accounted for 2.4% of primary ovarian epithelial carcinomas in their series and for 6.7% in our study (16 of 238 cases). The higher proportion of mucinous adenocarcinoma and other nonserous carcinomas in CMU hospital (Table 1) was probably correlated with the lower proportion of serous adenocarcinoma in Thailand compared to that of the Western series (32–37% versus 57% of primary ovarian carcinomas)[7,25]. We agree with the suggestion that some of the early data regarding primary ovarian mucinous adenocarcinomas in the literature may need to be reevaluated[7,10]. The diagnosis of primary mucinous adenocarcinomas of the ovary should not be based on pathologic examination alone, but a thorough

clinicopathologic evaluation is required. After exclusion of metastatic tumors, primary mucinous adenocarcinoma is an uncommon subtype of malignant ovarian epithelial tumors.

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